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ABSTRACT

APEX is a computerized gaming simulation; it is also the name of an interdisciplinary course in environmental problems in urban areas introduced at the School of Health Science, Hunter College of the City University of New York. In the course, students assume the roles of decision makers in both the private and public sectors. They receive data and make decisions necessary to "run" the community. Their decisions are used as input to a computerized simulation of the community. Results generated by the computer are used as the bases for subsequent problems and decisions. APEX stimulates student interaction and encompasses broad decision-making areas in an integrated manner. Student responses to the course has been positive, and there are plans to add more roles to the APEX simulation. (CH)

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APEX: A Computerized Simulation Game as the Basis for an Undergraduate Interdisciplinary Course

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JURY SELECTION BEGINS IN BRIBERY-EXTORTION TRIAL

> Jury selection began today in the bribery-extortion case of Vincent Coluccio and Larry Ellis. Mr Coluccio, the suspended head of the County Environmental Quality Agency, was indicted in November and accused of extorting a $1 million bribe from Mr. Ellis who is the Manager of the People's Pulp Company. At the same time, Mr. Ellis was also indicted for agreeing to the bribe and conspiring to pay it. It is alleged that in return for the $1 million Mr. Coluccio agreed to halt all present and future proceedings against People's Pulp for their flagrant violations of the County's clean air and pure water statutes. The trial is expected to begin next week in the courtroom of Judge Douglas Kramer.

Another Watergate? Perhaps, but this is Apex County and the two who were "indicted" are undergraduate students and the "judge" is an Assistant United States Attorney who happens to be a friend of their Professor. The course is APEX: Environmental Problems in Urban Areas and it is taught in the School of Health Sciences of Hunter College of the City University of New York.

In the course, students assume the roles of the decision makers in both the private and public sectors of a City and a County. They receive current and historic data and must make the necessary decisions to "run" the community. Their decisions are used as input to a computerized simulation of the community which in turn gives back the results of their actions to be used as the bases for their next decisions.

There have been undergraduate courses offered in the past in which computer models were employed to help illustrate certain principles or were the basis for laboratory experiences. In APEX, however, the computerized simulation is the foundation for more than half of the course. The other portion of the class meetings is devoted to guest lectures on relevant subjects.

This paper includes a history of the APEX simulation, how it is run, the hardware and software involved, the objectives of our course, how we use the simulation in our course, some examples of student projects for and reactions to the course, our future plans for the course, some caveats, and some general comments.

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History of APEX

In the early 1960's, some people at the Michigan State University who were studying urban planners decided to develop a computerized gaming simulation called METRO. They intended to have professional planners play the game. They would study the planners while they played and thus have a controlled environment for observing the planning process. It never quite worked out because the planners did not behave in the game as they did on the job -- they tried all kinds of utopian, unrealistic schemes which they never had the opportunity to try in the "real world."

But METRO was based on such a sophisticated computerized model of the City and County of Lansing, Michigan that it was decided to add an air model and use the game for training air pollution control officers. This involved support from the Federal Environmental Protection Agency and its predecessor agencies. The result was the METRO-APEX simulation (APEX is Air Pollution EXercise), which has been used quite successfully in the training of air pollution administrators. During 1973 and 1974, the game was updated and several new environmental roles (solid waste manager, water quality administrator, and environmental quality agency) were added to give what we now call "APEX." This recent revision was done by the COMEX Research Laboratory at the University of Southern California and they currently maintain and support APEX.

This current version of APEX is the result of scores of man-years of development over the last fifteen years. It is one of, if not the most sophisticated computerized gaming simulations in existence. It has been played by thousands of people all over the United States and in several foreign countries. It has been employed in numerous and varied settings ranging from one- or two-day seminars to full semester courses such as the one currently offered at Hunter and at one or two other colleges. The orientation of the sessions has been equally diverse, including such emphases as small group dynamics, urban politics, air pollution management, and computerized simulation, among many others.

This current version of APEX is a widely used, highly respected simulation. It is supported and maintained by several dedicated and skilled specialists in the COMEX Research Laboratory at U.S.C. There is an APEX Newsletter which is circulated regularly to active users and other interested parties. There are periodic training sessions conducted by COMEX for new users. The COMEX staff often consults by telephone with users who have problems. And there have been APEX sessions in conjunction with the National Gaming and Simulation conferences.

Running APEX

The computerized simulation called APEX is run as follows:

I. The computer is run to generate the starting point information (output) for the human players to use in their first "year" of running the community.

II. The human players assume various roles (e.g., county and city politicians, urban planners, environmental quality control officers, land developers, industrialists, pressure groups, news media, etc.) and using the starting point output, they interact to make the decisions necessary to "run" the community for a "year."

III. The results of the humans' decisions are coded and keypunched to be used as the input for the next computer run.

IV. Using the input generated in # III above, the computer is run to simulate the results of the humans' decisions and to produce the results as output which will be employed by the human players as their starting point data for "running" the community for the next "year."

V. The process is repeated, starting at step II, for as many "years" as are desired.

It is not necessary for people to know anything about computers or programming in order to play APEX and take our course. In fact, the computer is never actually used by the students. It is merely the vehicle for processing their decisions and simulating the results of these decisions.

Computer Hardware and Software

The current version of APEX is written almost entirely in FØRTRAN IV with one or two assembler language subroutines. It is normally implemented on an IBM /360 or /370 with at least 128K of core, disk or tape drives, a card reader, and a high speed printer. Some versions have been implemented on other vendor systems.

The original version of METRO-APEX was written for the IBM 1130 computer, but current versions have grown so large that a small computer cannot be employed. One very simplified version of APEX has been run using a programmable calculator, but the simplification is so great and the effort necessary so extensive that it is really incorrect to call it APEX.

In our course, we do our processing on the City University Computer Center's IBM /370 system via remote entry from either an IBM 2922 RJE station or a DEC PDP 11/20 via 9.8K or 2K Baud modems. Our CPU time per run varies from five to ten minutes and our turn-around time depends, of course, on current usage.

Objectives of the Course

In the School of Health Sciences of Hunter College, we need several interdisciplinary courses for our Health Science majors to help them gain an overview of the many interacting systems in our society and to allow them to begin to develop a sense of their own roles in relation to these systems. We want students to gain some experience with the realities of our governmental and political systems, with our industrial and commercial systems, with environmental pollution and its control, and with ordered planning. We want our students to become complete, aware citizens and health professionals, not mere technicians.

We feel that students learn best by doing and we need interdisciplinary courses which will involve the students in the course activities and force them to interact with each other. We also feel that bringing students together from several of our different health science majors as well as from the rest of the College helps to break down the artificial barriers which develop between health professions.

APEX as the Basis of a Course

Because the APEX computerized simulation is so complex and accurate and the decisions it requires of the human players are so realistic, the players are almost forced to play their roles very much as if they were real. This provides an excellent educational setting for studying the effects of various types of policies and behaviors and techniques for the interaction and cooperation of people in different disciplines and different positions.

We have found that APEX is a perfect vehicle for achieving the objectives stated above for several reasons:

a. APEX is very flexible and allows for whatever emphases we feel are necessary or timely.

b. APEX requires the participants to have a high degree of interaction with each other.

c. APEX can pause for special exercises or lessons or for guest lectures.

d. APEX encompasses many of the broad areas about which we want our students to learn and it does so in a realistic and integrated fashion, not as a piecemeal or awkward juxtaposition of various topics with the student left to make the synthesis.

We use APEX as the core of our course. We teach the students how to play the game during the first class meeting. We then play a cycle or two before beginning in alternate weeks to have guest lecturers on relevant subjects. During the Fall semester of 1975, we had lectures on political and economic planning, environmental impact statements, comprehensive health planning and financing, environmental law and court and enforcement proceedings, the role of pressure groups in urban politics and government, and financing the city. There is much discussion with the speakers and the students relate their experiences in the APEX simulation to the theories and realities described by the guests.

The crucial point is not that students are playing APEX, but that the APEX simulation allows, enhances, encourages, and even dictates interactions and learning which otherwise might not be possible. Giving students the opportunity to "be" politicians or industrialists or planners and to deal with the real problems of these and other roles is the great contribution of APEX.

Without the structure provided by the APEX simulation, such role playing would be non-directed, unrealistic, and without concrete feedback. However, in APEX, for example, if a politician overspends he will become intimately familiar with the realities of deficit financing, but if he underspends, he may not be reelected. If a planner "plans" unrealistically or without consulting as widely as he should, he will find his plans rejected or not followed.

The APEX simulation also forces interactions among participants by tying one player's output to another's decisions. For example, the pollution discovered by the Environmental Quality Agency depends in part on the decisions made by industrialists regarding production levels, fuels employed, and pollution control devices installed and operated. As a further example, the local taxes paid by the industrialists and developers and the budgets for the Environmental Quality Agency are determined by the politicians.

Many other interactions are encouraged or caused by the flow of the game. The planners must consider proposals from developers for rezoning. The pressure groups must lobby. New laws regarding the environment may be drafted by the Environmental Quality Agency, reported by the news media, opposed by the industrialists, supported or opposed by some of the pressure groups, passed or modified or defeated by the politicians, and implemented and enforced by the Environmental Quality Agency.

Student Projects

Students do two types of projects related to our course:

1. Projects related to and for the purpose of furthering some aspect of their roles during the simulation, and

2. Final projects in lieu of a final examination.

The following are some examples of the first type of project:

During the course given in the Fall semester of 1974, students in the news media role produced an excellent weekly newspaper of APEX; some students in the planning role tackled the problem of new housing for the lower class families displaced by a new freeway; a number of the politicians struggled with the need for, versus the cost of, urban mass transit. The politicians and environmentalists drafted, passed, and enforced a law requiring an environmental impact statement for all development in the County. This led the industrialists to band together to get their own candidates elected to office and they unseated several incumbent politicians and proceeded to repeal the new impact statement law.

During the course given in the Fall semester of 1975, the industrialists formed a Chamber of Commerce in order to present a united front on issues of common concern; the planners developed a regional plan for the entire city and county and presented it to the community; and one of the developers conceived a plan for a large scale housing project for the elderly, she convinced the local politicians to finance the project and then proceeded to build it and reap an obscene profit while appearing to serve the public interest and gaining a virtuous reputation.

Some examples of final projects submitted by students include: a brief videotape of APEX which attempts to capture some of the flavor of the simulation and the interactions; a summary and analysis of the procedures which the New York Telephone Company must follow in order to obtain a rate increase; a report on public hearings held by the Metropolitan Transportation Authority of New York regarding the Second Avenue subway at which one of the students in the course testified; an analysis of the technological advances and pollution problems of the paper pulp industry; and a critique of another large computerized simulation called "the River Basin Model."

Student Reactions

Student reaction to the course has been overwhelmingly favorable. Students have been asked to give written and oral critiques of the course during the last class meeting of the semester in addition to completing the standard Hunter College teacher evaluation survey. The critiques almost invariably cite positively the following aspects of the course:

1. It is different from any other course taken in College and the difference makes it interesting, exciting, and a challenge.

2. It is fun and learning should be fun.

3. It is relevant and realistic.

4. It forces interactions with other people in other roles in the simulation and thereby teaches about the dynamics of such interactions and the interdependence of roles in the real world.

5. It allows for the testing of ideas and plans in a simulated setting which could not be tried in the "real world" because of any number of factors such as cost, danger, lack of power, etc.

6. It allows students to "experience" roles and occupations completely foreign to their backgrounds.

7. It forces students to begin to think in much broader terms than previously because their actions clearly and immediately affect others and bring direct feedback.

8. There is a freedom imparted by role-playing which has a liberating effect on learning.

9. The freedom is balanced by the strong academic aspects of the guest lectures and the reality which they bring to the course.

The only negative comments by the students tend to focus on the logistics of the course:

1. Meeting once a week for three hours, while recognized as necessary, is sometimes burdensome.

2. The first week or two, while the game is being learned, are frequently quite confusing.

3. There are not enough experienced people around to serve as role-advisors

4. It is hard to get everything done during the three hours of class time, but even harder to get the necessary people together during the week between classes.

We recognize these logistics problems and try to work with students to minimize them. But, to a certain extent, they are inevitable and must be accepted as the price of all of the benefits of the course.

Future Plans

Our great success with this course in the past has led to its inclusion in our regular offerings. There exists an interactive program written in PL/1 for entering data to APEX, but it is incompatible with our interactive /370 system. We are developing our own interactive "prompter" through which players can enter their decisions directly to our computer, by-passing the hand-written coding forms and key-punching, but retaining hard-copy records of their decisions.

Because our primary emphasis is on the preparation of health professionals, we would like to add some roles to the APEX simulation. We are considering the addition of several hospitals with their "administrators", and city and/or county health departments and welfare departments. Such additions will require a very significant investment in role research, planning, programming, testing, manual authoring, and implementation. Funds are now being sought to support these activities.

Some Caveats

This is a very demanding course to offer.

1. The professor in charge must be available all week between cycles.

2. One person alone cannot handle the whole job. A minimum of three or four experienced role-advisors and a computer operator are essential.

3. The professor in charge should have attended a training session at COMEX and all the others should have played the game several times previously.

4. Role manuals should be purchased by every student ($6 to $8) and several reference manuals should be on reserve in the library.

5. Budget should be available for the reproduction of necessary decision and coding forms.

6. Computer time is about five to ten minutes of CPU on our very large /370 for each cycle. Trial runs should be made to plan appropriate budget and schedule.

7. All guest lectures should be carefully planned and the lecturers fully briefed in advance as to the nature and objectives of the course.

8. A large reference library is essential because the game touches on so many aspects of running a community that limited library resources may severely curtail the scope of activities possible.

9. A large, comfortable room with good work tables and space for fifty to seventy-five persons is necessary.

10. Ease of access to the computer and high speed printing are very important. Scheduled access is most desirable to assure timely output for the course.

11. Budget should be available for several telephone calls to the consultants at COMEX in California which may be necessary.

Comments

What has been discussed in this paper is both specific to the course offered at Hunter College and generalizable to a number of conceivable courses. APEX is so flexible that many different emphases are possible. Therefore, numerous different courses, each with its own focus, could be built around it. For example, courses in American Urban Politics, Business Management, Environmental Control, City Planning, or Small Group Dynamics could be based on the APEX game. Many others are possible. The only limitation is the imagination and energy of the professor.

Further bulletens on the trial of Vincent Coluccio and Larry Ellis will be read as received.